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TITLE: LOS ALAMOS REAL-TIME AND DIGITAL RADIOGRAPHY PLANS

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LOS ALAMOS REAL-TIME AND DIGITAL RADIOGRAPHY PLANS

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INTRODUCTION

Real-time radiography is the conversion of the radiographic image into a video image for display on a TV monitor. Once the image is in video format it is easy to digitize it using one of several digitizing systems. When the image has been digitized, digital signal processing may be performed on the image to enhance it or to assist the radiographer in interpreting. Digital processing may be performed in near real-time or off-line.

SYSTEM JUSTIFICATION

When considering a real-time radiographic system, the use of the system must be considered. At Los Alamos, we do not have a major production requirement and our principal use has been as a diagnostic tool for dynamic tests. Some others use it to assist in aligning a part to the correct orientation for a record radiograph.

For a possible production application, the following list shows items to be considered:

- Can offer reduction in expense cost (film)
- Can increase throughput
- Requires real-time interpretation
- Requires remote/automated manipulation of parts
- Requires high tech equipment and personnel (support)
- Archival requirements must be addressed
- Interpretation can be automated (pattern recognition).

DIGITAL SYSTEM DISCUSSION

The rest of this presentation will concentrate on the digital aspects of a real-time or near real-time system. This includes the computer capability for system control as well as the digitizing and processing of the video signals.

A video image or frame can be digitized using a variety of hardware techniques. Direct conversion of the video signal from a vidicon is done in 1/30th of a second. The readout of a charge coupled device (CCD) requires two to three seconds. A digital camera that mechanically scans a single detector or array of detectors across the image plane can

take one minute or more. The digitization of the video output from a vidicon is the most used technique. A typical frame size is 512 by 512 pixels, which requires up to 262144 8-bit conversions in 1/30th of a second. The typical digitizing system has a buffer memory or image plane to store these data within the same time. Look-up table conversion of the input and displayed data, and arithmetic operations are also performed at the same data rate.

The typical imaging systems have the following image processing capabilities:

Real-Time Processing
- Summing of data from two or more frames
- Contrast stretching using look-up tables
- Subtraction of two image planes
- Pseudo color display
- Graphic overlays

Near Real-Time Processing
- Filtering (enhancement)
- Histograms
- Mensuration
- Pattern recognition.

The image may also be transferred to the controlling computer for further processing or storage.

The overall system can be hardware-based or computer-based. In a hardware-based system, all of the functions are hard-wired into the system and cannot be easily modified. The operator controls the system using front panel switches. In a computer-based system, the hardware functions of the system are controlled by a computer or microprocessor in a programmed sequence. The operator probably interacts with the system through the computer keyboard. The computer handles all of the tasks involved in the system operation. This removes the built-in limitations of a hardware-based system, since the operation of the system and its functions can be changed by loading a new program.

If the program for a computer-based system is contained on ROM (firmware) and operator control is via a simple key pad, then the system can be said to be bundled and it looks like a hardware-based system. However, the system characteristics can be changed by the installation of new firmware.

Manufacturers of different types of video acquisition systems are listed here.

HARDWARE SYSTEM
  Quantex

BUNDLED SYSTEM
  Science Applications, Incorporated (SAI)

COMPUTER-BASED SYSTEMS
  Recognition Concepts (Q-bus, Unibus)
  Imaging Technology (Q-bus, Multibus)
  Datacube (Q-bus)

SYSTEM PLANS

Los Alamos is currently working on the assembly of three digital systems. These are all different and use different equipment.

The first is a hardware-based system that is being assembled for a field inspection task. The system consists of a Precise Optics image intensifier, Quantex DS-50 digitizer, 300 kV x-ray generator, and two XY scanning frames for the source and detector. The scanning is done using stock motor controllers. The Quantex is used to perform averaging of images to improve resolution. A record of the inspections is made on a video tape recorder.

The second is a production evaluation unit for HE evaluation. It will consist of a Precise Optics image intensifier, Imaging Technology IP-512 board set, DEC LSI-11/23 microcomputer, and a Winchester disc unit. The parts handling equipment is undefined at this time. The inspection is used for quality screening and no permanent record of the complete inspection will be maintained. Existing x-ray generators will be utilized.

The third system has a high resolution task that requires enlargement of the image to get the required resolution. The system will consist of a microfocus x-ray generator, a Recognition Concepts Trapix-5000 digitizing system, and a precision positioning stage. The magnification will be adjustable from 2 to 20 X. The x-ray image converter has not been specified yet.

The assembly and use of these systems should allow us to thoroughly evaluate each component and to determine the uses to which each is most suited.